COINVEDI

III International Congress on Construction and Building Research

Escuela Técnica Superior de Edificación
Universidad Politécnica de Madrid
Avda. de Juan de Herrera 6, 28040 Madrid, Spain

14th - 16th of December 2015

EXPERIMENTAL MECHANICAL CHARACTERISATION OF A ESTRUCTURAL LIGHTWEIGTH AGGREGATE CONCRETE ACORDING TO EC-2

Olmedo, Fernando Israel [1]; Cobo, Alfonso [1]; Díaz, Borja [2] and Vidal, María Ángeles [2]

(1) Universidad Politécnica de Madrid. fiolmedoz@aparejadoresmadrid.org
(2) LAFARGE.

Keywords: *Lightweight concrete, compression, EC-2*

1. Introduction – The self load of a structure is usually higher than the loads it has to carry. It means that these kind of structures are quite often inefficient. The replacement in concrete of the normal aggregate by other lighter materials leads to a significant fall in the concrete weight.

The normal aggregate has been replaced by lightweight aggregate since Roman Empire Ages. It has let singular buildings as Agripa´s Pantheon or the Coliseum in Rome. The evolution according to the age of the compression and tensile strength and the Elastic Modulus in a Lightweigth Aggregate Concrete (LAC) has been analysed in this paper. The concrete was produced by LAFARE. Its commercial name is THERMEDIA. The experimental researches has been compared with the predicted values by EC-2.

2. Methods – The research has been done with a mesh produced by LAFARGE. Expanded clay has been used has lightweight aggregate. The density was 700 kg/m^3 for lower aggregate and 650 kg/m^3 for upper one. The expected concrete´s density was 1500 kg/m^3. 24 cylindrical 15x30 cm pieces and 12 cubic one were made. The pieces were tested a age of 7, 14, 24 and 90 days. 3 cylindrical and 3 cubic pieces were tested at each age at compression stress and 3 cylindrical ones at tensile stress.

The Eurocode EC-2 [1] says that it is possible to guess all the mechanical values throw the measure compression stress (f_{cm}) at 28 days and the density(ρ), according to table 1.

Parameter	Estimaed value	Relation
$f_{cm(t)}$ (MPa)	$f_{cm(t)} = f_{cm} \cdot \beta_{cc(t)}$	$\beta_{cc(t)} = \exp\{s[1-(28/t)^{1/2}]\}$
$f_{ctm(t)}$ (MPa)	$f_{ctm(t)} = f_{ctm} \cdot \beta_{cc(t)}$	
f_{lctm} (MPa)	$f_{lctm} = f_{ctm} \cdot \eta_1$	$\eta_1 = 0{,}40 + 0{,}60\rho/2200$
E_{lcm} (GPa)	$E_{lcm} = E_{cm} \cdot \eta_E$	$\eta_E = (\rho/2200)^2$

Table 1.- Estimated mechanical values according to EC-2

3. Results and Discussion – The table 2 shows the measure values of the broken stress at each age, 7, 14 28 and 90 days. The table compares the tested and the estimated by EC-2 values, cylindrical and cubic pieces for compression and tensile stress. Moreover, the Elastic Modulus is indicated at compression tests. All the values are shown in MPa.

Age (days)	Density (kg/m³)	Compression					Tensile	
		cylindrical			Cubic			
		Pieze	σ (MPa)	E (MPa)	Pieze	σ (MPa)	Pieze	σ (MPa)
7	1515,29	**Meassure**	**23,17**	**10.800**	**Meassure**	**28,85**	**Meassure**	**2,12**
		EC-2	*24,36*	*13.633*	*EC-2*	*26,60*	*EC-2*	*2,05*
14	1511,65	**Meassure**	**26,82**	**10.978**	**Meassure**	**29,48**	**Meassure**	**2,55**
		EC-2	*26,09*	*13.667*	*EC-2*	*27,69*	*EC-2*	*2,09*
28	1511,33	**Meassure**	**26,81**	**11.145**	**Meassure**	**29,45**	**Meassure**	**2,69**
		EC-2	*26,61*	*13.766*	*EC-2*	*28,17*	*EC-2*	*2,12*
90	1510,98	**Meassure**	**27,00**	**11.200**	**Meassure**	**31,05**	**Meassure**	**2,70**
		EC-2	*26,16*	*13.662*	*EC-2*	*26,60*	*EC-2*	*2,15*

Table 2.- Meassure values of the broken stress at different ages

The figure 1 shows the evolution of the broken compressión stress, both for cylindrical (Cci) and cubic (Ccu), and tensile stress (T) at different ages (7, 14, 28 and 90 days). It is indicated as the experimental values as the expected by EC-2 value.

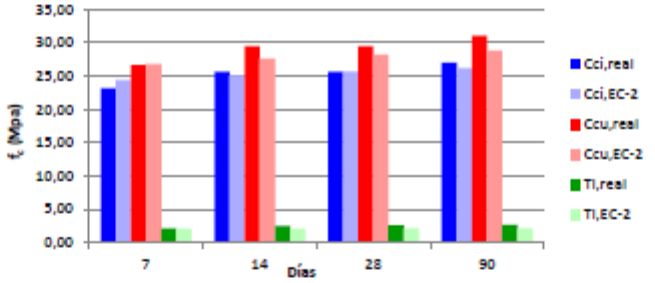

Figure 1.- Evolution of the broken stress at different ages

4. Conclusions – The estimated values by the EC-2, for each situation and each age, are always lower than the experimental ones, except for cylindrical compression at 7 days.

References

[1] European Union (2010). Eurocode 2: Design of concrete structure – Part 1-1: General rules and rules for building, Brussels, Belgium.